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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/573,211	01/17/2007	Yasutoshi Kawaguchi	OKUDP0163US	7642

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EXAMINER
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SAYADIAN, HRAYR

ART UNIT	PAPER NUMBER
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2814

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/573,211	<b>Applicant(s)</b> KAWAGUCHI ET AL.	
	<b>Examiner</b> HRAYR A. SAYADIAN	<b>Art Unit</b> 2814	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 21 June 2010.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) 3, 7-14 and 17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 4-6, 15, and 16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                    | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)         | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED OFFICE ACTION**

### **Applicant's Elections**

1. The 11/30/2009 and 8/24/2009 Replies responded to the Lack of Unity Requirements by electing, without traverse, claims 1, 2, 4-6, 15, and 16 for prosecution on the merits.

Accordingly, the 3/24/2010 Office Action withdrew claims 3, 7-14, and 17 from further consideration as being drawn to non-elected inventions and made final the requirements.

The Lack of Unity Requirements and their finality are proper and they are, therefore, maintained.

### **35 U.S.C. § 103 Rejections of the Claims**

2. The text of the appropriate paragraph(s) of 35 U.S.C. § 103, providing the legal basis for the obviousness rejection(s) in this Office Action, can be found in a previous Office Action.

3. Claims 1, 2, and 15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 5,646,953 to "Naito" in view of U.S. Pat. No. 6,456,640 to "Okumura" and PGPUB US 2003/0136970 of a U.S. patent application by "Takeya."

Naito discloses (see, for example, FIG. 8 and column 21, lines 19-30) A nitride semiconductor device comprising a p-type nitride semiconductor layer (5B-8B), an n-type nitride semiconductor layer (3B), and an active layer (4B) interposed between the p-type nitride semiconductor layer and the n-type nitride semiconductor layer, wherein, the p-type nitride semiconductor layer includes: a first p-type nitride semiconductor layer (the waveguide layer 5B) containing Al.

Naito appears to fail to disclose a second p-type nitride semiconductor layer containing Mg, the first p-type nitride semiconductor layer being located between the active layer and the second p-type nitride semiconductor layer, and the second p-type nitride semiconductor layer having a greater band gap than a band gap of the first p-type nitride semiconductor layer.

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The semiconductor art however well recognizes the benefits of such an arrangement.

Specifically, Takeya teaches placing a p-type (Mg-doped) GaAlN electron blocking layer so that the waveguide layer is between the EBL and the active layer. See, for example, element 11(p) in FIGs. 3 and 8. And Takeya teaches that the EBL 11(p) results in lower operating voltage. See, for example, the Abstract and see paragraphs [0140] - [0142], and see paragraph [0107] disclosing 11(p) being a p-type nitride layer containing Mg.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention of this application to have modified the semiconductor device Naito discloses by introducing a disclose a second p-type nitride semiconductor layer containing Mg, the first p-type nitride semiconductor layer being located between the active layer and the second p-type nitride semiconductor layer, and the second p-type nitride semiconductor layer having a greater band gap than a band gap of the first p-type nitride semiconductor layer, at least to lower the threshold voltage, as taught by Takeya.

Examiner notes that the EBL layer would have to have a bandgap larger than that of the waveguide layer for the blocking function to occur, as Takeya discloses.

Naito discloses the first nitride layer being p-type but fails to explicitly disclose it being doped by Mg to be p-type.

The semiconductor art however well knows that Mg is typically used as the p-type impurity in GaAlN. See, for example, paragraph [0014] Takeya.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention of this application to have modified the semiconductor device Naito discloses by using Mg as the dopant making the GaAlN first layer (the waveguide) p-type.

With respect to claims 15 and 16, Naito discloses using MOCVD to growth the layers of the device. But fails to detail the specifics of MOCVD method.

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The semiconductor art however well recognizes that the MOCVD growing method for the first and second p-type layers would be by supplying a source gas containing Al and a source gas containing Mg (see, for example, Takeya paragraph [0116] disclosing using the appropriate Al and Mg containing source gases to grow the layers).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention of this application to have grown the GaAlN p-doped layers disclosed in Naito by using the MOCVD method of using source gas containing Al and source gas containing Mg to grow the layers, as taught by Naito and Takeya.

4. Claims 4-6 and 16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over "Naito" and "Okumura," further in view of U.S. Pat. No. 6,456,640 to "Okumura."

The combined disclosure of Naito and Takeya fails to disclose there being a non-doped third layer between the active layer and the first layer, wherein the third layer contains Al, has a bandgap equal to the first layer, which bandgap is smaller than the bandgap of the second layer.

The semiconductor art however well knows the benefits of such an arrangement.

For example, Okumura teaches using a waveguide layer that comprises two sub-layers, one next to the active layer being undoped and the one on the other side of the non-doped waveguide sublayer being p-doped. See, for example, column 8, lines 21-38. And Okumura teaches that such an arrangement results in "fewer carriers exist[ing] in the guide layers, thereby reducing the amount of light absorbed by free carriers and allowing for further reduction of the oscillation threshold current."

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention of this application to have modified the first p-type layer Naito discloses by replacing it with an GaAlN layer comprising a third layer that is non-doped and that is next to the active layer and a first layer that is p-doped and is on the other side of the third layer from the active layer.

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Examiner notes that the material not changing results in the bandgap being the same, which is smaller than the EBL material bandgap.

### **Response to Arguments**

5. The arguments in the 6/21/2010 Reply have been fully considered. These arguments however are not found persuasive.

The Reply argues that the claims are allowable because "Takeya ... neither teaches nor suggests providing a first p-type nitride semiconductor layer containing Al and Mg between the active layer and the second p-type nitride semiconductor layer."

In coming to this conclusion, the reply notes that "Claims 1 and 15 recite 'a first p-type nitride semiconductor layer containing Al and Mg; and a second p-type nitride semiconductor layer containing Mg, the first p-type nitride semiconductor layer being located between the active layer and the second p-type nitride semiconductor layer.'" Next, the Reply submits that "[t]he Examiner's position appears to be that the first p-type nitride semiconductor layer of the presently claimed invention corresponds to the undoped InGaN optical waveguide layer 8 of Takeya et al., and the second p-type nitride semiconductor layer of the presently claimed invention corresponds to the p-type AlGaN electron blocking layer 11 of Takeya et al. (page 3, lines 8-9 of the Office Action)." The Reply however notes that "the undoped InGaN optical waveguide layer 8 of Takeya is an n-type layer (paragraph [0085] of Takeya et al.), while the first p-type nitride semiconductor layer of the presently claimed invention is a p-type layer." The Reply therefore concludes that the claims should be allowable because "Takeya ... neither teaches nor suggests providing a first p-type nitride semiconductor layer containing Al and Mg between the active layer and the second p-type nitride semiconductor layer."

In Response, as explained above in the rejection of claims 1 and 15, it is noted that Naito discloses a "p-type nitride semiconductor layer include[ing]: a first p-type nitride semiconductor layer (the waveguide layer 5B) containing Al." See, for example, FIG. 8, and column 21, line 25. Takeya is evidence that one of ordinary skill in the art

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would have been motivated to modify Naito to include "a second p-type nitride semiconductor layer containing Mg, the first p-type nitride semiconductor layer being located between the active layer and the second p-type nitride semiconductor layer."

Specifically, Takeya teaches placing a p-type (Mg-doped) GaAlN electron blocking layer so that the waveguide layer is between the EBL and the active layer. See, for example, element 11(p) in FIGs. 3 and 8. And Takeya teaches that the EBL 11(p) results in lower operating voltage. See, for example, the Abstract and see paragraphs [0140] - [0142], and see paragraph [0107] disclosing 11(p) being a p-type nitride layer containing Mg.

And contrary to the Reply's contradictory contention, first recognizing that Takeya discloses layer 8 to be undoped and then arguing that layer 8 is an n-type layer (by pointing to paragraph [0085], which does not even mention layer 8, let alone disclose it to be n-type), Takeya specifically teaches placing the layer 11(p) (the EBL p-type layer) so that the waveguide layer 8 is between the EBL layer 11(p) and the active layer. See, additionally, for example, paragraph [0105].

Clearly, therefore, it would have been obvious for one of ordinary skill in the art, in view of the teachings (disclosure and motivation) of Takeya, to have modified the disclosure of Naito so that a second p-type nitride semiconductor layer containing Mg (the EBL 11(p)) is placed so that the first nitride layer of Naito would be between the active layer and the second nitride layer.

Recognizing that layer 8 is an undoped waveguide, then contending, without basis in fact, that it is n-type doped and therefore rendering the claims allowable is not persuasive.

Accordingly, rejecting the claims claim unpatentable over the prior art is proper and is therefore maintained.

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## CONCLUSION

### 5. THIS OFFICE ACTION IS MADE FINAL.

A shortened statutory period for reply to this Office Action is set to expire **THREE MONTHS** from the mailing date of this Office Action. Applicant is reminded of the extension of time policy as set forth in 37 CFR § 1.136(a).

If a first reply is filed within TWO MONTHS of the mailing date of this Office Action and the advisory Office Action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory Office Action is mailed, and any extension fee pursuant to 37 CFR § 1.136(a) will be calculated from the mailing date of the advisory Office Action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this Office Action.

Any inquiry concerning this communication or earlier communications from an Examiner should be directed to Examiner Hrayr A. Sayadian, at (571) 272-7779, on Monday through Friday, 7:30 am – 4:00 pm ET.

If attempts to reach Mr. Sayadian by telephone are unsuccessful, his supervisor, Supervisory Primary Examiner Wael Fahmy, can be reached at (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available only through Private PAIR. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. The Electronic Business Center (EBC) at (866) 217-9197 (toll-free) may answer questions on how to access the Private PAIR system.

/Hrayr A. Sayadian/

Patent Examiner, Art Unit 2814